Critical Analysis Team Report on Silos 1 and 2 Accelerated Waste Retrieval Preliminary Design

CAT Report Number 13

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The Critical Analysis Team (CAT) has reviewed the Preliminary Design of the Silos 1 and 2 Accelerated Waste Retrieval (AWR) Project. Due to time constraints, the CAT only completed a cursory review of the design documentation. In general, the Preliminary Design provides a suitable basis for moving forward with Definitive Design.

The CAT realizes that some of the following comments may not be applicable until definitive design. Still other comments are more programmatic in nature. However, past project experience shows that all of these issues must be addressed for project success. Exactly how and when they are addressed is up to FDF and Foster Wheeler (F-W).

The CAT's most significant concern is that the AWR project may be being used as a test vehicle for the EMMA arm. Further, the design is complicated because of EMMA, which will only be used for heel removal.

As the AWR design has evolved, the use of EMMA and its associated equipment and structures is greatly complicating the design. Following are a few examples of the CAT's concerns surrounding the use of EMMA, related equipment and the EMMA Deployment Tower (EDT):

- Maintenance will be difficult. Access to cameras, hoists, lifting devices, rollers, and cables in the EDT will be extremely challenging. EMMA itself will fill much of the EDT, leaving little space for workers to perform maintenance. Further, the EDT will likely...

  ...be a confined space.
  ...be hot in the summer.
  ...be cold in the winter.
  ...be dark and humid with little ventilation.
  ...require the use of long breathing air hoses or Scott backpacks.
  ...require a buddy system.
  ...provide barriers to worker communication.
  ...add personnel risks due to lightening and wind storms.
  ...be extremely difficult to evacuate in emergencies.

  As a result of these demanding conditions, maintenance efforts will be difficult and worker productivity low. The EDT will be inaccessible for any worker not in the best physical condition—if a worker is injured due to

stresses in the EDT, it will be extremely difficult to evacuate that worker. Time and motion studies need to be completed for worker activities in the EDT. The RAM analysis that is going to be complete must be 'hands-on' oriented, not analytical. This RAM should also be realistic about how much a worker can accomplish in a given time period under these working conditions.

- The sheer size of the EDT (90 feet above the silo) makes movement of this assembly between silos a significant challenge.
- The current EDT design does not appear to have provisions for personnel working platforms, electricity and/or air for power tools, communications systems, lighting or personnel fall protection. These items will be required.
- Wind may effect the utility of EMMA because of the EDT height. That is, EDT movement will translate into EMMA movement.
- Remotely operating EMMA and the associated end effectors will be complicated. Numerous remote operators will be needed to simultaneously operate pumps, sluicers, and EMMA. Using remote viewing devices (TV) limits operator work periods to about 2 hours because of fatigue, thus requiring additional trained operators. Training for these workers will be extensive.
- Installation, removal, and repair of EMMA and related equipment will be time consuming.
- What EMMA experience provides confidence that EMMA can work in this application for 1000 hrs without failure as stated on page 13 of the System Design Description (624-P622-30)? This page also states that EMMA is designed to work at a maximum humidity or 15%—which is obviously not the condition in the silos.
- The EDT door is eleven feet by three feet and, according to the design, could be under a negative pressure of two inches of water. If this is correct, 4400 pounds of force will be required to open the door.

Even though EMMA and the EDT are driving the complexity of the design, they are only being used to accomplish heel removal. An approach that eliminates EMMA would have the potential to reduce risks, reduce costs, and increase reliability. The Foster Wheeler Value Engineering Study (Document 624-P622-43; recommendation SWRS-2-8) recommended considering other technologies for heel removal. The CAT recommends that, concurrent with definitive design work, a value engineering study be conducted to determine a more practical heel and discrete object removal approach that does not require EMMA and the EDT.

Bentonite Issues

Bentonite concentration in the waste slurry is likely to vary considerably. The presence of bentonite at varying concentrations raises the following concerns:

- Higher levels of bentonite in the slurry may lead to plugging the slurry lines and ultrafiltration system.

- Continuous recirculation of the bentonite will not be practical in the ultrafiltration system. Therefore, Foster Wheeler should consider technologies for removing the bentonite. The CAT suggests contacting bentonite vendors to identify appropriate technologies.
- Foster Wheeler should ensure that the Transfer Tank Area (TTA) tanks provide adequate volume for the fully hydrated bentonite.

To ensure that bentonite problems are adequately addressed, the CAT recommends a small scale test loop to fully understand bentonite settling characteristics, plugging characteristics, and demonstrate an unplugging approach.

Other issues of concern

Again, some of the following concerns may not be applicable directly to the Preliminary Design. FDF can determine which comments are appropriate to pass on to F-W. Others must continue to be considered as the design and other project activities move forward

Currently, the drawings and the text are difficult to follow and interpret. Both the drawings and the text should be simplified to make reading and analysis more straightforward and reader-friendly.

It is not clear that Foster Wheeler had adequately considered secondary waste issues. The bentonite stream and the AWWT are examples.

Currently the AWR design assumes operation six hours per day. Assuming startup, shutdown and system flushing at both ends of a shift, full retrieval operation for six hours per day is overly optimistic. Given current productivity factors, it is unlikely that the system would actually operate for 6 hours each day.

Process system problems are generally experienced during start-up and shutdown. Therefore, an evaluation of a 24-hour operation should be completed. To deal with settling-time issues, addition of a centrifuge or another mechanism for speeding liquid/solids separation should be considered. 24-hour operating period provides significant potential to reduce maintenance issues and save money by completing the project much earlier.

P. 78 of the System Design Description (624-P622-30) refers to hydraulic oil in the SREE. Risks and impacts of leaking oil into the silo must be considered.

Using a sluicing nozzle to carve a channel to direct slurry to the sluicing pump will be technically challenging. This operation would be greatly simplified were a slurry pump placed in the middle of the silo with a sluicing nozzle on each side. This is confirmed on page 32 of the System Design Description (624-P622-30) which outlines the design of the TTA tanks in just this manner.

The document has multiple contradictions (e.g. different sluicing pressures). The CAT assumes these will be checked and corrected in the next version of the document. This may indicate a lack of inter/intra squad checking. Foster Wheeler must be disciplined in its approach; FDF should not be responsible for document checking.

FDF should ensure it reviews these documents from an overall systems viewpoint to ensure all systems are appropriately integrated.

The design documentation needs more technical justification for sluicing and water jet pressures (e.g. 150 psi is sufficient to break-up/dissolve the bentonite layer and move material up to fifty feet, but 10,000 psi is needed to remove "loose and visible contamination" during heel removal. This seems somewhat inconsistent). Also, does the use of 10000 psi raise silo leak or equipment damage concerns?

The current design assumes operation of sluicer/slurry pump and concurrent dome and wall washdown by EMMA. This may not be wise, since it could lead to accidental equipment contact and possible damage.

In-tank/over tank lifts should be evaluated as to whether or not they will be identified as "critical".

Cation concentrations should be included on the Process Flow Mass Balance to better understand potential water treatment needs. Because cations are not currently included in the mass balance, it cannot be determined whether the effluent will meet AWWT requirements.

Current placement of the stack could lead to exhaust gases being drawn into the top of the sluicer module, slurry module and EDT.

The design needs a more realistic assumption about in-leakage through silo walls as the berm is removed (it currently assumes no in-leakage). Current knowledge on past dome in-leakage (before sealing) may be useful in making a conservative estimate.

P. 39 of the System Design Description (624-P622-30) identified a design worker exposure of 800 mrem per year. Does this violate the Fernald administrative limit of 500 mrem/year?

When debris is removed from the silo, manually placing the lid on the drum could lead to significant unnecessary worker exposure. Placing the lid remotely should not be very difficult or costly.

A spray-ring water rinse may not provide sufficient D&D for the sluicing nozzle, debris basket, or EMMA.

A comprehensive analysis of potential in-tank accidents and recovery needs to be completed. This is particularly important given the technical risks associated with EMMA. Consideration should include retrieval of a damaged and/or immobilized EMMA.

Each tower silo entry module has a HEPA filter. This seems to be overly redundant. One HEPA at bridge level with connecting ducts to each tower should be sufficient.

As part of the design criteria and RAM analysis, any equipment requiring lubrication, calibration, etc. should not (to the extent practical) be located in a radiation area

The document states that, near the silo, the berm will be removed manually with a 1:1 excavation slope. This is likely too steep, and may be unsafe. Also, a vacuum machine should be considered to remove berm rather than manual shoveling.

Any plan of moving pumps and instrumentation from tank to tank in the TTA should be reconsidered. Currently, it is planned to move level indicators and pumps as tanks are filled and then emptied. It will probably reduce costs and exposure risks to simply buy and install multiple sets of instrumentation. This would also provide added flexibility.

It is not clear how the slurry line cleanout systems will be used. This should be clarified in definitive design. A value engineering study to consider the need for these cleanout systems is appropriate. The planned spare slurry system already provides some flexibility. Also, if the project is run for 24 hrs/day instead of 6hrs/day, there may be less need for the slurry cleanout system.

The CAT remains concerned about assumptions in the silos project concerning AWWT. If AWWT and its requirements are not given full consideration, it could quickly become a constraining factor in AWR or Silos 1 and 2 treatment.

Recommendations

In addition to the above concerns, following are the CAT's primary recommendations:

Recommendation 13-1: The CAT recommends that, concurrent with definitive design work, a value engineering study be conducted to determine a more practical heel and discrete object removal approach that does not require EMMA and the EDT.

Recommendation 13-2: To ensure that bentonite problems are adequately addressed, the CAT recommends a small scale test loop be fabricated to fully understand bentonite settling and plugging characteristics.

Recommendation 13-3: Cation concentrations should be included on the Process Flow Mass Balance to better understand potential water treatment needs.

Recommendation 13-4: An evaluation of operating 24 hours per day should be completed.

Recommendation 13-5: A RAM analysis should be completed. This analysis must be 'hands-on' oriented, not analytical. The RAM should also be realistic about how much a worker can accomplish in a given time period under anticipated working conditions.